Too Busy to Be Manipulated:

How Multitasking with Technology Increases Deception Detection Performance in Collaborative Team Work

ABSTRACT

Deception detection is an unfortunate necessity in group work. Guarding against team member's alternative agendas is difficult, and may seem even more difficult in technology-driven business environments that have made multitasking during teamwork increasingly commonplace. This research develops a foundation for a nuanced theoretical understanding of deception detection under these conditions. The intersection of information technology multitasking and deception detection theories are shown to produce various and sometimes competing ideas as to how this type of multitasking might affect truthfulness assessments in real-time team work. A laboratory study involving a collaborative game helped evaluate the different ideas using manipulated deception and multitasking behaviors in a real-time, virtual group environment. The results provide evidence that information multitasking can actually improve truthfulness assessments, likely because multitaskers engage less in the team conversation, making themselves less manipulable. As understanding of multitasking benefits increase, managers and designers can incorporate effective multitasking into collaborative processes.

Keywords: deception detection; multitasking; groups; performance; StrikeCOM

INTRODUCTION

Deception is an unfortunate staple of group work [6], and computer-mediated environments exacerbate the problem [29]. As if critical and creative thinking weren't challenging enough for collaborative projects, team members must gauge the truthfulness of other members generally to guard against hidden agendas. Failing at this task can result in faulty decision making that undermines project objectives [29] or betrays organizational values. Much evidence suggests that even with plenty of material to work with, accurately gauging truthfulness is difficult [12] even for experienced personnel [14]. To make matters worse, the computer-mediated collaboration systems that enable dispersed interactions unintentionally create more deception [5], even though they can lead to more information sharing [49].

Gauging truthfulness may be becoming even further complicated by the current IT-driven workplace: There is a growing trend of employee multitasking, probably due to increased number and mobility of communication technologies, and greater expectations of productivity and accessibility [67,69,70]. This increase in multitasking has become commonplace in group meetings and group collaborative work [18,24]. Such multitasking behavior seems likely to significantly impact a group member's ability to assess the veracity of the information that is being received. For example, how well can the employee who is responding to texts while in a virtual work meeting detect that a colleague is lying about his ability to complete a critical project? Or, how well can the remote investor who is distracted by a phone call detect that his financial team member is purposely overstating expected growth? Endless similar questions could be asked, and the answers translate into performance gains or losses. But little is known about how the new technology-enabled multitasking phenomenon affects deception detection.

The purpose of the present research is to investigate the impact of multitasking on deception detection. Given the sometimes contradictory or competing outcomes in multitasking research, this study seeks to provide a foundation or a starting point for a nuanced theoretical model of deception detection when multitasking, by empirically evaluating truthfulness assessments in a multitasking scenario. This research first reviews relevant literature related to deception and multitasking and contextualizes it within the problem space. Multiple possible mechanisms are proposed including at least one that is unique to the intersection of the two research domains. A laboratory experiment is then described, which involved 129 participants (in groups of three) completing a collaborative seek-and-destroy game. Analyses and results of hypothesis testing are reported. Finally, the theoretical implications of this research are discussed.

Deception Detection in Team Environments

While some prior research has investigated using groups to detect deception external to the group (e.g., [48,74]), little empirical research has directly investigated deception detection within the team itself: There is evidence that deception diminishes team performance [28], and that more deception is present in virtual versus co-located groups [29,44]. To glean more insight relevant to the task at hand we must look to the deception detection domain more generally.

Deception detection research commonly cites deception theories which argue that liars exhibit behavioral or psychophysiological indicators that can be used to identify their deception. These indicators are posited to come from underlying cognition or emotion "leaking" out even if liars try to appear truthful [26], or in some cases *because* they try to appear truthful [73,79]. Much information systems research in this domain has investigated automated solutions (e.g., [38,58,59,73]), partly for efficiency gains (e.g., [53,63,75]), but in large measure because ample empirical evidence shows that people are generally not good at detecting deception [25,36].

However, most of the poor detection results are based on binary choice scenarios (i.e., deceptive or truthful), using one-way interactions or third-person observations (e.g., [27]). The lion's share of human deception detection accuracy research leverages experiments in which participants identify deception in highly-controlled environments (e.g., a participant sits in a lab and watches a video of an interaction and is then asked to judge if deception has taken place) [25].

Detecting deception in team settings is different. In collaborative settings, truthfulness estimations are not commonly binary—more often they lie on a scale. Except in cases of obvious and continuous deception, team members implicitly gauge just how truthful a team member is rather than labeling them fully deceptive or completely honest. The strength of a truthfulness estimation naturally influences how much a team member will rely on or discount another team member's input.

Real-time team interactions provide another important difference from much of deception detection research, in that these truthfulness estimations are influenced by dynamic, unstructured conversation rather than mostly one-way interrogations or third-person observations. Interpersonal Deception Theory (IDT) proposes that this dynamic nature of interactions heavily impacts truthfulness assessments: the deceiver adjusts her communication in response to perceived indicators of suspicion, and the receiver adjusts her communication in response to perceived indicators of deception [17,43]. Given that most people struggle identifying deception and tend to show a bias toward presuming truthfulness [41], this back-and-forth process over time seems to favor the deceiver's success in evading detection [15].

Information Technology Multitasking Costs and Benefits

Multitasking has been defined as the engagement of an individual in multiple goal-independent tasks that are performed concurrently [8,10], often involving a "shift in the focus of attention when tasks are swapped" [76:2]. This definition of multitasking encompasses a wide range of scenarios, from cooking dinner while talking with a family member to texting while driving. Of particular interest to management information systems is the multitasking which occurs during information processes that may impact the value proposition [52], such as the multitasking during collaborative team work made possible by information and communication technologies.

Such information technology multitasking is increasingly prevalent due to a number of factors including the ubiquity of information technologies (e.g., [61]) as well as the move toward organizational structures that require employees to work on multiple sometimes distributed teams [21]. Multitasking with technology (hereafter shortened to *multitasking*) is described in the literature using a variety of terms including computer-based multitasking, technological multitasking, mobile multitasking, and digital multitasking, and is closely related to (and can draw on the research of) behaviors such as media multitasking and multicommunicating.

Making use of brief but unavoidable wait time between objectives is one potential benefit of multitasking [65]. Multitasking may help improve productivity when it takes advantage of this wait time before the primary objective can resume [2]. This is probably why workers who strategically manage multiple team memberships in an organizational setting can enhance productivity [54].

However, multitasking is common even when tasks have little or no such wait time efficiencies to leverage. Most multitasking research investigates these types of scenarios, and reports a drop in performance (e.g., [1,47,66]), or increased errors [1,4,18,22,30,50]. For instance, one study reported that multitasking among online customer service agents creates a reduced rate of problem resolution, resulting in decreased customer satisfaction [33].

Cognitive theories and models of rapid task switching and dual-task interference [50,56,77] provide insight into why performance decreases: multitasking usually involves resource *interference*: the goal-independent tasks simultaneously require the same cognitive resources. This resource allocation problem necessitates either sharing the resource between the tasks, or switching the resource back and forth between tasks [60]. The re-orienting of cognitive attention when switching tasks introduces performance costs seen in prior studies, such as latency [2,23], confusion [2,18], inability to maintain attention or manage information [3], and increased stress and frustration [4,45]. These negative effects may be amplified to the extent tasks are dissimilar [31,51]. When there are no efficiency gains for multitasking, the effects of these *switching costs* become more apparent.

A variety of human factors further affect a person's ability to perform effectively when multitasking, including mental ability [78], emotional state [46], and the person's polychronicity disposition (i.e., the tendency to favor engaging in multiple vs. a single task at a time [35,40]).

With so many costs and challenges stemming from multitasking, it is little wonder that most multitasking studies identify performance detriments. But a select few have proposed performance benefits of multitasking beyond eliminating downtime. While a majority of extant research on multitasking implies or proposes an inverse linear relationship between multitasking and performance [1,2,60], some recent studies suggest that the relationship between multitasking and performance may be more complex [1,2,64]. In one study, a moderate amount of multitasking resulted in more errors, but better productivity compared to a low amount of multitasking. It was suggested that task juggling triggers an increase in cognitive arousal to match cognitive demand [1]. Besides increased cognitive arousal, knowledge or skills gained from one task may transfer to another [20], and in some cases unique properties among two tasks can create synergistic effects when combined [9,42].

Truthfulness Assessments When Multitasking

The existing theories and research on multitasking and deception offer different and potentially conflicting perspectives on how multitasking during real-time collaboration team work may influence assessments of truthfulness.

A negative relationship between multitasking and performance has been found in a large body of literature from a variety of contexts [39,55,68]. Drawing on the oft-cited theories of dual-task interference and rapid task switching [50,77], we propose a negative relationship between multitasking and deception detection performance. More particularly, we suggest that significant multitasking while engaging in teamwork will create interference, leaving fewer attentional resources available to allocate toward interpersonal communication. The switching costs that will occur as a result may cause lack of attention toward some verbal and non-verbal communication from other team members. In this way, we expect multitasking to diminish a team member's interpersonal communication performance. We further propose that this lack of conversational attention means less awareness of potential behavioral indicators of deception. Truthfulness assessments may suffer as a result.

H1a: Multitasking decreases communication performance.

H1b: Poorer communication performance decreases deception detection performance.

However, the above logic implies that in this context, attention allocation is a zero-sum game, and it treats all attention as equal. These may not be appropriate assumptions for this problem space. Increased task juggling may trigger "increase[d] levels of arousal and mobilize cognitive resources to handle increased levels of load" [1:159]. Thus, it may be that multitasking creates more cognitive effort, which may lead to a deeper processing of the behavioral cues that are seen and heard.

H2a: Multitasking increases cognitive effort.

H2b: Cognitive effort increases deception detection performance.

The above hypotheses investigate the differing views we extrapolated from existing multitasking research, as we propose they apply to deception detection in team work. However, we must also consider the dynamic nature of interpersonal deception [13], which involves sending and receiving communicated deception and suspicion. When the target of a deception is experiencing switching costs, her focus is somewhere other than the team communication.

We suggest that during these times the target can neither recognize deception indicators nor send indicators of suspicion. As a result, deception that requires a lot of explanation may be too complex for a less-engaged team-member, who will miss some of the deception tactics and be less susceptible to the manipulation. Perhaps more importantly, deceivers theoretically rely on their target's behavioral indicators to reveal how well their deception is working, and throughout an interaction they adjust their own behaviors based on this verbal and nonverbal feedback [15]. If her target is not engaging well in the conversation, the deceiver may have a corresponding decrease in indicators that allow her to effectively adjust. To the extent these factors play a significant role, we would expect an opposite result to H1b:

H3: Poorer communication performance increases deception detection performance.

That these are competing hypotheses is not surprising given that these mechanisms have not previously been explored in this context, or in the same study. When theories predict differing results, competing hypotheses are an appropriate approach to begin evaluating the competing ideas [32,62]. Because both ideas predict directional effects, competing hypotheses are different from an exploratory approach where no theory is evaluated. Different members of the research team favored competing outcomes to the research prior to data collection, which made for an interesting project. While the outcomes of this single study cannot definitively support or reject either idea, they can provide initial support for one over others for this context, and they can provide a foundation for even more nuanced theoretical development in the future.

METHODOLOGY

A laboratory experiment was conducted using ad-hoc, three-person teams. Participants (N=129) were recruited from the student population of a large university in the southwestern United States. Prior to participation, each filled out a survey which captured demographic and personality data.

Experiment Description

Each team played a collaborative game called StrikeCOM, which has been previously used for team-related research to measure a variety of phenomena, including: group dynamics, communication quality, task performance, mutuality, trustworthiness, and deception [11,16,28,37,72]. It is one of a growing number of collaborative games used for this type of research application (e.g., also see CollabSec [71]). In StrikeCOM, the team's objective is to identify the location of an uncertain number of enemy targets (e.g., hidden enemy bases) by allocating investigative resources to selected areas on a map grid.

Each member of the team is given a different investigative resource, each with varying reliability. For instance, a team member assigned to the intelligence commander role has the option of using a "message interceptor" asset to search three vertically consecutive cells on the grid. The information returned has a lower probability of being correct compared to information obtained from a human spy resource that allows a more restricted search space. The final phase of the game is the "strike" phase, at which point the team must decide which grid cells on the map to strike. Team members are not shown the information gathered by other team members, so collaboration is necessary for optimal performance.

Experiment Procedures

Each member of the three-person teams was randomly assigned to one of three roles: Air commander, Space commander, or Intelligence commander. The three team members were stationed in different rooms to ensure that each participant could not see the other participants' screens. The team members communicated with one another via audioconference.

All three team members watched an instructional video showing them how to play the game, and completed a practice round to ensure understanding. They were then given their specific mission objective, which was to find hidden enemy bases. Participants filling the Intelligence commander role (i.e., Deception condition) were given an additional instruction: they were told to try to undermine the team's mission by doing all that they could to keep the hidden bases from being hit. The Air and Space commanders also received additional instructions just before beginning the game. They were told that there was an anonymous tip that someone on the team might be trying to undermine the mission, but that it might be a false lead. This had the effect of producing a team comprised of one deceiver and two truth tellers who were somewhat primed to look for deception. We felt the slight priming was necessary to counter the possible perception that no deception would occur in a sanctioned laboratory experiment. However, this feature also means caution should be exercised when extending results to teams who implicitly trust one another.

The Air commander (i.e., Multitasking condition) was also given an additional instruction, namely to complete an additional task while playing the game. This task was to answer periodic questions from the "Administrative Leader" using a chat window. During gameplay, this team member typed answers to questions that appeared in the chat window about every 90 seconds. The questions were open-ended, required reflective thought, and were irrelevant to the game (e.g., “What is the most difficult activity you have done this year?”). The inclusion of this cognitively engaging but irrelevant task ensured that the Air Commander was engaged in multiple technology-enabled, goal-oriented tasks that were completed concurrently [8,10], within a simulated virtual team collaboration environment. This audio and text type of multitasking is among the most common types of multitasking for this context [70].

Measures

After the game, each participant completed a survey that included Likert-scale ratings of the perceived truthfulness of each of the other two members of the team. Truthfulness questions about the deceiver are shown in Table 1. These exhibited a high level of reliability (Cronbach’s α=.95).

Table 1. Example Truthfulness Questions

ID	Question Text
T1	The Intel Commander on my team was providing correct information.
T2	The Intel Commander was trying to get the team to succeed at discovering hidden bases.
T3	The Intel Commander was honest about the information he or she shared.

The perceived truthfulness rating of the deceiving team member is the main phenomenon of interest: a lower rating indicates that the participant was better able to detect the untruthfulness of the deceiver. A single-item question was included after truthfulness ratings, asking the individual how confident he or she was in their opinion of the team member’s truthfulness.

The survey also included measures of cognitive effort and communication performance.

Perceived cognitive effort (Cronbach's α=.90) was measured via an adapted four-item scale used in prior research [57] to self-report the mental difficulty of a task. Communication performance (Cronbach's α=.77) was likewise measured using an adapted scale from prior research [19]. The pre-task survey captured two of the control variables, namely the personality trait *agreeableness* (Cronbach's α=.82), which was measured using a subset of the standard psychometric instrument [34], and an adapted scale for voice-and-text multitasking experience [55] (Cronbach's α=.94).

ANALYSIS AND RESULTS

Data for nine of the participants were excluded because they were unable to complete the game due to technical or scheduling issues. An additional five teams were excluded because the team member assigned to the deception condition self-reported their own truthfulness as four or higher on a 7-point Likert scale. For two participants, a survey error prevented collection of truthfulness judgments of the deceiver. This left 35 teams including 103 participants available for analysis.

For the multitasking manipulation check, participants were asked to self-report their perceived level of multitasking during gameplay on a 7-point Likert scale. Participants in the multitasking condition reported significantly higher levels of perceived multitasking ($\bar{X} = 4.86$) compared to those in the no-multitasking condition ($\bar{X} = 3.65$).

A multilevel regression model was specified, with perceived truthfulness (of the deceiver) as the outcome variable and multitasking condition as the independent variable. Three variables were included as covariates: the first was the participant's self-reported confidence of their truthfulness judgment of the team member. The second was the personality trait agreeableness, which is thought to correlate with a more trusting disposition. The third was self-reported experience with the audiovisual-and-typing type of multitasking, which is the particular type of multitasking used in this experiment. Each participant's team was included as a random effect to control for inter-group differences. Deceivers were excluded from this analysis (leaving N=68 observations). The results of which are shown in Table 2.

Table 2. Multilevel Regression Results

Random Effects	**Variance (St. Dev)**
Team	0.16 (0.40)
Residual	1.54 (1.24)
Variable	**Effect (St. Error)**
[Intercept]	1.23 (1.21)
Multitasking (Air Role)	-0.71 (0.32)*
Judgment Confidence	0.21 (0.10)*
Agreeableness	0.50 (0.21)*
Multitasking Experience	0.10 (0.11)

*Notes: N=68; *p < .05; model fit using maximum likelihood.*

Table 3 shows the mean ratings of the truthfulness of the deceiver, by each role.

Table 3. Mean Truthfulness Ratings by Role

Air Role (Multitasker)			**Space Role (Non-multitasking)**
Air Rating of Space	4.79	5.02	Space Rating of Air
Air Rating of Intel	4.56	5.12	Space Rating of Intel

Note: Participants in the Intel role were the deceivers.

Those in the multitasking condition reported a significantly lower perceived truthfulness of the deceiver as compared to those in the non-multitasking condition. The team member's confidence and the personality trait agreeableness each produced the expected effect, increasing perceived truthfulness of the deceiver. Experience with this type of multitasking did not produce a significant effect.

Mediation analyses were conducted to evaluate cognitive effort and communication performance as potential mediators of multitasking's effect on deception detection performance.

Mediation analysis was chosen over SEM-based approaches because it is sufficient for the task and SEM-based approaches typically require larger sample sizes. The mediation analyses followed the Baron and Kenny [7] approach. The first step of this approach—showing that the causal variable (multitasking) is correlated with the outcome—was established in the previous analysis. To evaluate whether multitasking is correlated with cognitive effort, a multilevel regression model was specified, using the same random effect as before, but using cognitive effort as the outcome variable. Multitasking was significantly ($p < 0.05$) and positively correlated with cognitive effort (b=0.764). Similar regression analyses revealed that cognitive effort was not significantly correlated with the truthfulness rating (b = -0.203), therefore the data do not support the idea the cognitive effort mediates the relationship between multitasking and truthfulness assessment.

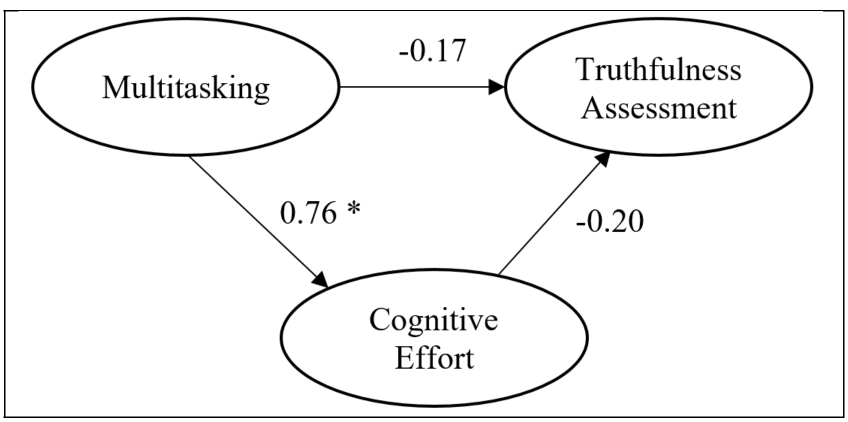

Figure 1. Mediator analysis showing that multitasking's effect on cognitive effort does not affect truthfulness assessment.

The same process was followed for communication performance. Multitasking was significantly (p=0.000) and negatively correlated with communication performance (b=-1.214), and communication performance was significantly ($p<0.01$) and positively correlated with the truthfulness rating (b=0.335). In the latter case, the direct effect of multitasking (-0.173) was no longer significant (p=0.641), suggesting full mediation (see Figure 2). Comparing the AIC criteria between the mediated and non-mediated model revealed no significant difference in model fit (χ^2 = 0.230), further supporting the idea that communication performance is a full mediator [7].

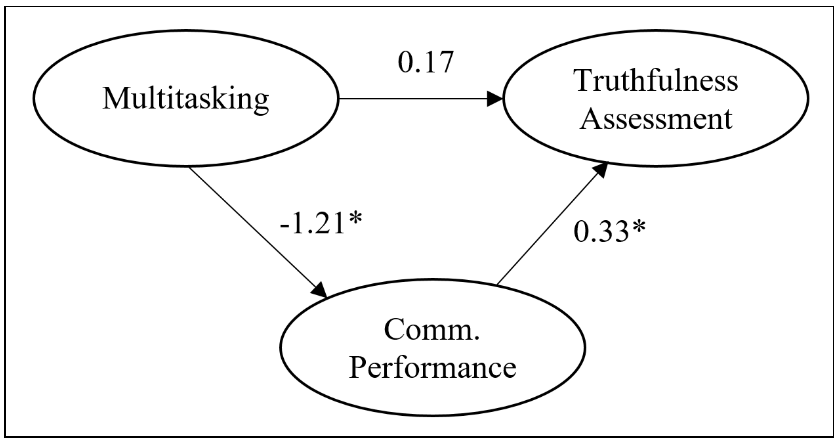

Figure 2. Mediator analysis showing that multitasking affects truthfulness assessment through communication performance.

In summary, the mediation analysis provides evidence that cognitive effort was not a mediator, while communication performance fully mediates the relationship between multitasking and the truthfulness rating.

DISCUSSION

The purpose of this study was to examine the impact of multitasking on team members' ability to detect deception. Expanding on past research, multiple hypotheses were proposed, two of which were directly competing. The large experiment was designed to help identify the effect and which mechanism(s) might be driving the effect. Table 4 summarizes the empirical support for the proposed hypotheses.

Table 4: Summary Results

	Hypothesis	Result
H1a	Multitasking decreases communication performance	Supported
H1b	Communication performance increases deception detection performance	Not supported
H2a	Multitasking increases cognitive effort	Supported
H2b	Cognitive effort increases deception detection performance	Not supported
H3	Communication performance decreases deception detection performance	Supported

The results show that on average, deception detection improved among those team members who were multitasking—performing an additional disparate task. The effect was present after controlling for personality-based performance effects. Confidence effects were also accounted for: although multitaskers' low confidence seemed to push all of their truthfulness ratings lower, there was an additional separate effect. That multitasking would improve deception detection in real-time collaborative decision making may seem counterintuitive, because there is little time efficiency advantage to multitasking.

We anticipated that perhaps the increased cognitive arousal created by multitasking could create this improvement. But that hypothesis was not supported. Multitasking appears to have indeed increased cognitive effort, but that increase does not appear to be the driver of better truthfulness estimates. Some deception detection literature questions whether the average person has significant ability to detect deception through interpersonal behavioral cues [25,36]. If such ability is truly minimal, then increased cognition may have minimal impact at best. If individuals do have greater than minimal ability, the performance boost from increased cognition would need to be greater than the performance costs from task switching. That difference was not present in this case, or at a minimum was not strong enough to be detected.

Strangely enough, it is the multitasker's *lack* of conversational engagement that appears to have improved truthfulness assessment.

Deceivers morph their tactics over the course of interactions, modifying their deception based on verbal and nonverbal feedback from team members [17,43]. It follows, then, that when team members provide fewer points of feedback for the deceiver, the deception may not be delivered as effectively. In short, multitasking may starve the deceiver of feedback.

It may also diminish the effectiveness of complex deception tactics. The cognitive switching costs associated with multitasking diminishes the attention that can be allocated to the deceiver's attempts to allay suspicion. When deception involves complex or unclear reasoning, multitasking receivers may not have time to try and make sense of it, leaving a level of suspicion in place instead of reasoning it away.

Contributions

This study examined for the first time how multitasking impacts a team member's ability to detect deception, and it begins to reveal the mechanisms underlying this impact. Specifically, the results suggest that in team-based interactive settings, deception detection performance may be increased when detectors multitask, and that performance increase probably stems from avoidance of manipulative communication rather than an increase in detective skill. This knowledge has straightforward implications for managing teamwork and designing effective collaborative teamwork systems, especially in high-stakes decision making.

This study also contributes to the multitasking literature. Our finding that multitasking can have a positive task performance outcome (increased deception detection) is in contrast which much of the multitasking literature which almost uniformly finds a negative relationship between multitasking and performance. This highlights the importance of studying multitasking in different contexts with different outcome variables.

This study supplies deception theories with insight into how competing tasks affect the dynamic deception process. To the extent that the receiver's conversational distraction inhibits the deceiver, alternate methods of detection that similarly limit receiver feedback may improve detection.

Theory involving multitasking during collaborative decision making is surprisingly sparse in management and systems research domains. Given the differing results among various multitasking research that is extant, it seems likely that properties of the tasks (and the multitaskers) heavily influence the relationship between multitasking and performance. We are careful to contextualize the findings from this study in terms of the properties of the task that are theoretically relevant to the proposed mechanisms: This was a real-time interactive, team-based decision-making task, paired with a dissimilar synchronous task. That it was a real-time, team-based task is an important constraint as it precludes performance gains from eliminating down time, which downtime is generally nonexistent for these types of tasks. The interactive nature of the task is what afforded the performance gains—such gains would not be expected in one-way information delivery. Future research can be more impactful in this area if it identifies more key task properties that mediate or moderate the multitasking-performance relationship.

Future Research

In other words, while typical future research might seek to establish the same effect in different cultures and socioeconomic groups, more impactful future research might further identify how the properties of the multitasking experience affect performance costs and benefits. Inhibited communication performance was a result of *resource interference*, meaning some of the same resources were required for both tasks (i.e., attention allocation, computer use). This interference prevented completely simultaneous operation and introduced switching costs. However, to the extent that the tasks involved do not share resources, such as listening to music while working, interference and switching costs approach zero. In such cases the efficiency benefits and interaction effects may come at an extremely low cost. Whether deception detection performance would improve during zero-interference multitasking or other types of multitasking beyond the scope of this study is far from certain, and demands additional research designed to build an increasingly comprehensive model.

A more complete vision of multitasking costs and benefits for various interactive tasks would help managers and experience engineers design collaborative efforts, piggybacking one type of task onto another so as to leverage the unique benefits of multitasking those activities.

CONCLUSION

Team-based decision making necessarily involves truthfulness assessments, and it is increasingly done in the context of multitasking. Prior to this study, research in this area pointed to multiple possible mechanisms. This study also integrated both multitasking and deception detection theories to propose a unique possibility, and provided empirical evidence supporting that outcome. Specifically, it showed that multitasking can improve truthfulness assessments by diminishing the deceiver's ability to manipulate the multitasking target. These groundbreaking insights call for further examination to create a more nuanced theoretical understanding of multitasking when manipulation is present. They also point to a broader area of opportunity for research and practice, namely, purposefully designing multitasking to produce performance gains and minimize losses. To make this possible, future research needs to identify crucial mediating experience factors and moderating task properties, such as those identified in this study, that boost or diminish outcomes when those factors and properties are combined.

REFERENCES

1. Adler, R.F. and Benbunan-Fich, R. Juggling on a high wire: Multitasking effects on performance. *International Journal of Human-Computer Studies*, *70*, (2012), 156–168.
2. Aral, S., Brynjolfsson, E., and Van Alstyne, M. Information, technology, and information worker productivity. *Information Systems Research*, *23*, 3, Part 2 of 2 (2012), 849–867.
3. Ashkenas, R. To multitask effectively, focus on value, not volume. *Harvard Business Review*, 2009.
4. Bailey, B.P. and Konstan, J.A. On the need for attention-aware systems: Measuring effects of interruption on task performance, error rate, and affective state. *Computers in Human Behavior*, *22*, 4 (2006), 685–708.
5. Barkhi, R. Information exchange and induced cooperation in group decision support systems. *Communication Research*, *32*, 5 (2005), 646–678.
6. Barkhi, R., Jacob, V.S., and Pirkul, H. The influence of communication mode and incentive structure on GDSS process and outcomes. *Decision Support Systems*, *37*, 2 (2004), 287–305.
7. Baron, R.M. and Kenny, D.A. The moderator-mediator variable distinction in social psychological research – conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*, 6 (1986), 1173–1182.
8. Benbunan-Fich, R. Developing a theory of multitasking behavior. In *International Conference on Information Systems*. Orlando, FL, 2012, pp. 1487–1500.
9. Benbunan-Fich, R. Measurement of multitasking with focus shift analysis. In *International Conference on Information Systems*. Orlando, FL, 2012, pp. 2230–2243.
10. Benbunan-Fich, R., Adler, R.F., and Mavlanova, T. Measuring multitasking with activity-based metrics. *ACM Transactions on Computer-Human Interaction*, *18*, 2 (2011), 7.1-7.22.

11. Biros, D.P., Hass, Wiers, K., et al. Task performance under deceptive conditions: Using military scenarios in deception detection research. In *38th Hawaii International Conference on System Sciences*. Hawaii, USA, 2005.
12. Bond, C.F. and DePaulo, B.M. Accuracy of deception judgments. *Personality and Social Psychology Review*, *10*, 3 (2006), 214–234.
13. Buller, D.B. and Burgoon, J.K. Interpersonal deception theory. *Communication Theory*, *6*, 3 (1996), 203–242.
14. Burgoon, J.K., Buller, D.B., Ebesu, A.S., and Rockwell, P.A. Interpersonal Deception: V. Accuracy in deception detection. *Communication Monographs*, *61*, 4 (1994), 303–325.
15. Burgoon, J.K., Buller, D.B., and Floyd, K. Does participation affect deception success? A test of the interactivity principle. *Human Communication Research*, *27*, 4 (2001), 503–534.
16. Burgoon, J.K., Nunamaker Jr, J.F., and George, J.F. *Detecting deception in the military infosphere: Improving and integrating human detection capabilities with automated tools*. Air Force Office of Scientific Research, 2007.
17. Burgoon, J.K. and Qin, T. The dynamic nature of deceptive verbal communication. *Journal of Language and Social Psychology*, *25*, 1 (2006), 76–96.
18. Cameron, A.F., Barki, H., Guinea, A.O., Coulon, T., and Moshki, H. Multicommunicating in meetings: Effects of locus, topic relatedness, and meeting medium. *Management Communication Quarterly*, *32*, 3 (2018), 303–336.
19. Cameron, A.F. and Webster, J. Relational outcomes of multicommunicating: Integrating incivility and social exchange perspectives. *Organization Science*, *22*, 3 (2011), 754–771.
20. Cameron, A.F. and Webster, J. Multicommunicating: Juggling multiple conversations in the workplace. *Information Systems Research*, *24*, 2 (2013), 352–371.
21. Cameron, A.F., Webster, J., Barki, H., and Guinea, A.O. Four common multicommunicating misconceptions. *European Journal of Information Systems*, *25*, 5 (2016), 465–471.
22. Charron, S. and Koechlin, E. Divided representation of concurrent goals in the human frontal lobes. *Science*, *328*, 5976 (2010), 360–363.
23. Czerwinski, M., Horvitz, E., and Wilhite, S. A diary study of task switching and interruptions. In New York, 2004, pp. 175–182.
24. Dennis, A.R., Rennecker, J.A., and Hansen, S. Invisible whispering: Restructuring collaborative decision making with instant messaging. *Decision Sciences*, *41*, (2010), 845–886.
25. DePaulo, B.M., Lindsay, J.J., Malone, B.E., Muhlenbruck, L., Charlton, K., and Cooper, H. Cues to deception. *Psychological Bulletin*, *129*, 1 (2003), 74–118.
26. Ekman, P. and Friesen, W.V. Nonverbal leakage and clues to deception. *Psychiatry*, *32*, 1 (1969), 88–106.
27. Elkins, A.C., Dunbar, N.E., Adame, B., and Nunamaker Jr., J.F. Are users threatened by credibility assessment systems? *Journal of Management Information Systems*, *29*, 4 (2013), 249–262.
28. Fuller, C.M., Marrett, K., and Twitchell, D.P. An examination of deception in virtual teams: Effects of deception on task performance. *IEEE Transactions on Professional Communication*, *55*, 1 (2012), 20–35.

29. George, J.F., Marett, K., and Giordano, G. Deception: Towards an individualistic view of group support systems. *Journal of the Association for Information Systems*, *9*, 10 (2008), 653–676.
30. Gilbert, S.J. and Shallice, T. Task switching: A PDP model. *Cognitive Psychology*, *44*, 3 (2002), 297–337.
31. Gillie, T. and Broadbent, D. What makes interruptions disruptive? A study of length, similarity, and complexity. *Psychological Research*, *50*, 4 (1989), 243–250.
32. Glass, D.H. Competing hypotheses and abductive inference. *Annals of Mathematics and Artificial Intelligence*, (2019), 1–18.
33. Goes, P.B., Ilk, N., Mingfeng, L., and Zhao, J.L. When more is less: Field evidence on unintended consequences of multitasking. *Management Science*, *64*, 7 (2018), 3033–3054.
34. Goldberg, L.R. The development of markers for the Big-Five factor structure. *Psychological Assessment*, *4*, 1 (1992), 26–42.
35. Hall, E.T. *The hidden dimension*. Doubleday, New York, NY, 1976.
36. Hartwig, M. and Bond Jr., C.F. Why do lie-catchers fail? A lens model meta-analysis of human lie judgments. *Psychological Bulletin*, *137*, 4 (2011), 643–659.
37. Helquist, J.H., Burgoon, J.K., and Weirs, K. Effects of modality richness and deception on communication quality and task performance. In *40th Hawaii International Conference on System Sciences*. Hawaii, USA, 2007.
38. Ho, S.M., Hancock, J.T., Booth, C., and Liu, X. Computer-mediated deception: Strategies revealed by language-action cues in spontaneous communication. *Journal of Management Information Systems*, *33*, 2 (2016), 393–420.
39. Horrey, W.J. and Wickens, C.D. Examining the impact of cell phone conversations on driving using meta-analytic techniques. *Human Factors*, *48*, 1 (2006), 196–205.
40. Lee, H. Time and information technology: Monochronicity, polychronicity, and temporal symmetry. *European Journal of Information Systems*, *8*, 1 (1999), 16–26.
41. Levine, T.R., Park, H.S., and McCornack, S.A. Accuracy in detecting truths and lies: Documenting the "veracity effect." *Communication Monographs*, *66*, (1999), 125–144.
42. Lindbeck, A. and Snower, D.J. Multitask learning and the reorganization of work: From tayloristic to holistic organization. *Journal of Labor Economics*, *18*, 3 (2000), 353–376.
43. Marett, K. and George, J.F. Deception in the case of one sender and multiple receivers. *Group Decision and Negotiation*, *13*, 1 (2004), 29–44.
44. Marett, K. and George, J.F. Barriers to deceiving other group members in virtual meetings. *Group Decision and Negotiation*, *22*, 1 (2013), 89–115.
45. Mark, G., Gudith, D., and Klocke, U. The cost of interrupted work: more speed and stress. In New York, 2008, pp. 107–110.
46. Mark, G., Iqbal, S., Czerwinski, M., and Johns, P. Focused, aroused, but so distractible: Temporal perspectives on multitasking and communications. In *18th ACM Conference on Computer Supported Cooperative Work & Social Computing*. Vancouver, BC, Canada, 2015, pp. 903–916.
47. McFarlane, D.C. Comparison of four primary methods for coordinating the interruption of people in human-computer interaction. *Human-Computer Interaction*, *17*, 1 (2002), 63–139.
48. McHaney, R., George, J.F., and Gupta, M. An exploration of deception detection: Are groups more effective than individuals? *Communication Research*, *45*, 8 (2018), 1103–1121.

49. Minas, R., Potter, R.F., Dennis, A.R., Bartelt, V., and Bae, S. Putting on the thinking cap: Using NeuroIS to understand information processing biases in virtual teams. *Journal of Management Information Systems*, *30*, 4 (2014), 49–82.
50. Monsell, S. Task switching. *Trends in Cognitive Sciences*, *7*, 3 (2003), 134–140.
51. Navon, D. and Gopher, D. On the economy of the human-processing system. *Psychological Review*, *86*, 3 (1979), 214–255.
52. Nunamaker Jr., J.F. and Briggs, R.O. Toward a broader vision for information systems. *ACM Transactions on Management Information Systems*, *2*, 4 (2011), 20.
53. Nunamaker Jr., J.F., Derrick, D.C., Elkins, A.C., Burgoon, J.K., and Patton, M.W. Embodied conversational agent-based kiosk for automated interviewing. *Journal of Management Information Systems*, *28*, 1 (2011), 17–48.
54. O'leary, M.B., Mortensen, M., and Woolley, A.W. Multiple team membership: A theoretical model of its effects on productivity and learning for individuals and teams. *Academy of Management Review*, *36*, 3 (2011), 461–478.
55. Ophir, E., Nass, C., and Wagner, A.D. Cognitive control in media multitaskers. *Procedings of the National Academy of Sciences*, *106*, 37 (2009), 15583–15587.
56. Pashler, H. Dual-task interference in simple tasks: Data and theory. *Psychological Bulletin*, *116*, 2 (1994), 220–244.
57. Patton, M. Decision Support for Rapid Assessment of Truth and Deception Using Automated Assessment Technologies and Kiosk-Based Embodied Conversational Agents. 2009.
58. Pentland, S.J., Twyman, N.W., Burgoon, J.K., Nunamaker Jr, J.F., and Diller, C.B. A video-based screening system for automated risk assessment using nuanced facial features. *Journal of Management Information Systems*, *34*, 4 (2017), 970–993.
59. Proudfoot, J.G., Jenkins, J.L., Burgoon, J.K., and Nunamaker Jr, J.F. More than meets the eye: How oculometric behaviors evolve over the course of automated deception detection interactions. *Journal of Management Information Systems*, *33*, 2 (2016), 332–360.
60. Rubinstein, J., Meyer, D., and Evans, E. Executive control of cognitive processes in task switching. *Journal of Experimental Psychology: Human Perception and Performance*, *27*, 4 (2001), 763–797.
61. Saunders, C., Wiener, M., Klett, S., and Sprenger, S. The impact of mental representations on ICT-related overload in the use of mobile phones. *Journal of Management Information Systems*, *34*, 3 (2017), 803–825.
62. Schupbach, J.N. and Glass, D.H. Hypothesis competition beyond mutual exclusivity. *Philosophy of Science*, *84*, 5 (2017), 810–824.
63. Siering, M., Koch, J.A., and Deokar, A.V. Detecting fraudulent behavior on crowdfunding platforms: The role of linguistic and content-based cues in static and dynamic contexts. *Journal of Management Information Systems*, *33*, 2 (2016), 421–455.
64. Singh, D. Does multitasking improve performance? Evidence from the emergency department. *Manufacturing & Service Operations Management*, *16*, 2 (2013), 168–183.
65. Slocombe, T.E. and Bluedorn, A.C. Organizational behavior implications of the congruence between preferred polychronicity and experienced work-unit polychronicity. *International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *20*, 1 (1999), 75–99.

66. Stanley, S.M., Elrod, C.C., Twyman, N.W., and Zou, C. Shopping on the go: How walking influences mobile shopping performance. *International Journal of Electronic Marketing and Retailing*, *9*, 4 (2018), 307–319.
67. Stephens, K.K. Multiple conversations during organizational meetings: Development of the multicommunicating scale. *Management Communication Quarterly*, *26*, (2012), 195–223.
68. Strayer, D.L. and Johnston, W.A. Driven to distraction: Dual-task studies of simulated driving and conversing on a cellular telephone. *Psychological Science*, *12*, 6 (2001), 462–466.
69. Turner, J.W. and Reinsch Jr., N.L. The business communicator as presence allocator: Multicommunicating, equivocality, and status at work. *The Journal of Business Communication*, *44*, 1 (2007), 36–58.
70. Turner, J.W. and Reinsch, N.L. Successful and unsuccessful multicommunication episodes: Engaging in dialogue or juggling messages? *Information Systems Frontiers*, *12*, 3 (2010), 277–285.
71. Twitchell, D., Fuller, C.M., Biros, D., and Marett, K. CollabSec: A multi-player game for researching and teaching information systems risk assessment. In Orlando, FL, 2012.
72. Twitchell, D.P., Wiers, K., Adkins, M., Burgoon, J., and Nunamaker Jr, J.F. Strikecom: A multi-player online strategy game for researching and teaching group dynamics. In *38th Hawaii International Conference on System Sciences*. Hawaii, USA, 2005.
73. Twyman, N.W., Elkins, A.C., Burgoon, J.K., and Nunamaker Jr., J.F. A rigidity detection system for automated credibility assessment. *Journal of Management Information Systems*, *31*, 1 (2014), 173–201.
74. Twyman, N.W., Jenkins, J.L., Carl, K., and Nunamaker Jr, J.F. Knowledge sourcing and knowledge consumption in computer-mediated complex decision making. In Koloa, HI, 2011.
75. Twyman, N.W., Lowry, P.B., Burgoon, J.K., and Nunamaker Jr., J.F. Autonomous scientifically controlled screening systems for detecting information purposefully concealed by individuals. *Journal of Management Information Systems*, *31*, 3 (2014), 106–137.
76. Waller, M.J. Preferences, behaviors, and strategies in multiple-task performance. In Dansereau and Yammarino, eds., *Multi-Level Issues in Organizations and Time*. Emerald Group Publishing, 2007, pp. 239–247.
77. Watanabe, K. and Funahashi, S. Neural mechanisms of dual-task interference and cognitive capacity limitation in the prefrontal cortex. *Nature Neuroscience*, *17*, 4 (2014), 601–611.
78. Watson, J.M. and Strayer, D.L. Supertaskers: Profiles in extraordinary multitasking ability. *Psychonomic Bulletin & Review*, *17*, 4 (2010), 479–485.
79. Zuckerman, M., DePaulo, B.M., and Rosenthal, R. Verbal and nonverbal communication of deception. *Advances in Experimental Social Psychology*, *14*, 1 (1981), 1–59.

APPENDIX

Measurement Items (All items were measured on a 1-7 scale)

Communication Performance
During the conversation-I lost my train of thought at times.
During the conversation-I felt like I was not holding up my side of the conversation.
During the conversation-I sometimes missed questions or comments made by others in the conversation.
During the conversation-I made some mistakes.

Note: The scoring on the above items was reversed so that increases in estimated effects would translate to increased performance

Cognitive Effort
How hard was it mentally to participate in the game?- Difficult
How hard was it mentally to participate in the game?- Challenging
How hard was it mentally to participate in the game?- Easy
How hard was it mentally to participate in the game?- Simple

Agreeableness
Please indicate how much you disagree or agree with each of the following statements:
I feel little concern for others
I am interested in people
I insult people
I sympathize with others' feelings
I am not interested in other people's problems
I have a soft heart
I am not really interested in others
I take time out for others
I feel others' emotions
I make people feel at ease

Multitasking Experience
How often do you use both of these types of communication at the same time?
Audio conference and email
Audio conference and texting